



Application No: GB 9818147.2
Claims searched: 1-8

Examiner: Matthew Lawson
Date of search: 5 November 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): C7A (including EP, WO & US)

Int Cl (Ed.6): F16D 65/12

Other: Online: JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 737510 (MADSEN) the whole document, particularly page 1 lines 8-36 & lines 59-67 and page 2 lines 3 & 5-10.	1,3-7
X	EP 0272788 A1 (FORD) page 2 lines 52-55, page 3 lines 25-30	1-7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9718982.3
Claims searched: 1-8

Examiner: R.B.Luck
Date of search: 4 November 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): C7A Optics

Int CI (Ed.6):

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2204592	Akebono Brake Industry Co Ltd	1 at least
X	GB1085715	Escher Wyss A.G.	1 at least
A	GB0435656	Crane Limited	1 at least
X	EP0473007	F.Winter,Eisengiesserei O.H.G.	1 at least
A	EP0272788	Ford Motor Company Limited	1 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family

A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

P/ PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

DRURY, Peter, Lawrence
T & N Limited
Manchester International Office
Centre
Styal Road
Manchester M22 5TN
ROYAUME-UNI

Date of mailing (day/month/year) 22 March 1999 (22.03.99)	
Applicant's or agent's file reference TNT 2621	IMPORTANT NOTIFICATION
International application No. PCT/GB98/02526	International filing date (day/month/year) 21 August 1998 (21.08.98)

1. The following indications appeared on record concerning:		
<input checked="" type="checkbox"/> the applicant	<input type="checkbox"/> the inventor	<input type="checkbox"/> the agent <input type="checkbox"/> the common representative
Name and Address T & N TECHNOLOGY LIMITED Cawston House Cawston Lane Rugby Warwickshire CV22 7SA United Kingdom	State of Nationality GB	State of Residence GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:		
<input type="checkbox"/> the person	<input checked="" type="checkbox"/> the name	<input type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence
Name and Address FEDERAL-MOGUL TECHNOLOGY LIMITED Cawston House Cawston Lane Rugby Warwickshire CV22 7SA United Kingdom	State of Nationality GB	State of Residence GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	
3. Further observations, if necessary:		
4. A copy of this notification has been sent to:		
<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned	
<input type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned	
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:	

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Ting Zhao
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark
Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 21 April 1999 (21.04.99)	
International application No. PCT/GB98/02526	Applicant's or agent's file reference TNT 2621
International filing date (day/month/year) 21 August 1998 (21.08.98)	Priority date (day/month/year) 09 September 1997 (09.09.97)
Applicant HOLME, John, David	

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

11 March 1999 (11.03.99)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer S. Mafla Telephone No.: (41-22) 338.83.38
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TNT 2621	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB98/02526	International filing date (day/month/year) 21/08/1998	Priority date (day/month/year) 09/09/1997
International Patent Classification (IPC) or national classification and IPC C22C37/00		
Applicant FEDERAL-MOGUL TECHNOLOGY LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 11/03/1999	Date of completion of this report 1 0 11 99
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Badcock, G Telephone No. +49 89 2399 8445 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB98/02526

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1,3-6	as originally filed			
2	as received on	08/10/1999	with letter of	06/01/1999

Claims, No.:

7	as originally filed			
1-6	as received on	08/10/1999	with letter of	06/01/1999

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-7
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-7
Industrial applicability (IA)	Yes:	Claims	1-7
	No:	Claims	

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB98/02526

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB98/02526

1. Amendments Art.34(2b)

The amended claims and page 2 of the description are considered to be based upon subject matter which was disclosed in the originally filed documents.

2. Clarity, Art.6 PCT

- 2.1. The phrase "...carbide forming metals.." in claim 1 is unclear. It neither gives an indication as to which metals could be considered as carbide forming, nor does the description give any indication as to the propensity of a metal to form a carbide. This will depend upon many factors other than the metals present, such as the carbon content and the cooling rate from the melt.

The objection could be overcome by listing the carbide forming metals, excluding vanadium and titanium, as tungsten, chromium, molybdenum and niobium. Claim 2 is in this respect not limiting since it refers to the phrase "also including". An allowable phrase would be to replace it with "consisting".

- 2.2. It would also appear from the description that the feature of "the vanadium must be equal or less than half the copper added to twenty times the titanium content" is essential to the invention, in particular in achieving the wear resistance of the rotor, (cf. page 3, middle and page 4, penultimate paragraph). The omission of this apparently essential feature results in a lack of clarity to the extent that the aims of the invention may not be achieved.

3. Novelty, Art.33(2)

None of the documents cited in the International Search Report discloses a disc brake rotor with the compositional limitations given in claim 1. The disc brake rotor of claim 1 is novel.

The closest prior art is considered to be JP-A-2 138 438 which discloses rotors for disc brakes with good wear properties, high strength, good damping properties and good resistance to thermal cracking. The rotor is made of grey cast iron containing 0.20-2.0 wt.% Cu, 0.05-1.0 wt.% Cr, 0.4-1.2 wt.% Mo, 0.05-0.10 wt.% Ti and 0.02-0.35 wt.% V. A compositional overlap with the claimed composition is, therefore, very narrow. None of the exemplified steels in the patent document discloses a steel falling within the claimed range. The claimed compositional

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB98/02526

limitation alleges an improvement in the thermal fatigue and wear resistance.
Hence the claimed rotor composition must be considered a novel selection.

4. Inventive step, Art.33(3)

The selection of a brake rotor comprising a grey cast iron with the compositional limitations of claim 1 convincingly solves the problem of wear resistance and thermal fatigue, assuming that the term "hard carbide forming metals" consists of at least one of the group of tungsten, chromium, molybdenum and niobium as well as both of titanium and vanadium (see item 2 above). The solution provided is not considered obvious for the skilled man. Without such a limitation however, it would not be possible to foresee whether the aims of the invention could be achieved.

5. Industrial applicability, Art.33(4).

The subject matter of the claims is deemed industrially applicable.

PATENT COOPERATION TREATY

Express Mail #EL389673128US

P

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

T&N plc
Attn. DRURY, P.
Bowdon House
Ashburton Road West, Trafford Park
Manchester, M17 1RA
UNITED KINGDOM

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

GROUP PATENTS

Date of mailing
(day/month/year) **30/10/1998**

Applicant's or agent's file reference

TNT 2621

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/GB 98/ 02526

International filing date
(day/month/year)

21/08/1998

Applicant

T&N TECHNOLOGY LIMITED et al.

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicants's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest: the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority

European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Paul Faux

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference TNT 2621	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 98/ 02526	International filing date (day/month/year) 21/08/1998	(Earliest) Priority Date (day/month/year) 09/09/1997
Applicant T&N TECHNOLOGY LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable(see Box I).
2. ☐ Unity of invention is lacking(see Box II).
3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
 - ☐ filed with the international application.
 - ☐ furnished by the applicant separately from the international application,
 - ☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
 - ☐ Transcribed by this Authority

4. With regard to the **title**,
 - ☐ the text is approved as submitted by the applicant
 - ☒ the text has been established by this Authority to read as follows:

DISC BRAKE ROTOR WITH A GREY CAST IRON COMPOSITION

5. With regard to the **abstract**,
 - ☒ the text is approved as submitted by the applicant
 - ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

Figure No. _____

- ☐ as suggested by the applicant.
- ☐ because the applicant failed to suggest a figure.
- ☐ because this figure better characterizes the invention.

☒ None of the figures.

Information on patent family members

PC./GB 98/02526

Form PCT/ISA/210 (patent family annex) (July 1992)

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/02526

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C22C37/00 F16D65/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C22C F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 377 (C-0748), 15 August 1990 & JP 02 138438 A (NISSAN MOTOR CO LTD), 28 May 1990 see abstract	1-4,6,7
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 462 (C-549), 5 December 1988 & JP 63 183150 A (RAILWAY TECHNICAL RES INST), 28 July 1988 see abstract	1-4,6,7
X	PATENT ABSTRACTS OF JAPAN vol. 010, no. 276 (C-373), 10 September 1986 & JP 61 096055 A (JAPANESE NATIONAL RAILWAYS;OTHERS: 01), 14 May 1986 see abstract	1-4,6,7
-/--		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

26 October 1998

Date of mailing of the international search report

30/10/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Badcock, G

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/02526

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 095, no. 011, 26 December 1995 & JP 07 216495 A (HITACHI METALS LTD), 15 August 1995 see abstract ---	1-7
A	EP 0 778 355 A (DAIMLER BENZ AG) 11 June 1997 cited in the application -----	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/02526

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0778355 A	11-06-1997	DE 19545611 C	13-03-1997

0.2-0.8 wt% niobium and 0.3-0.5 wt% copper. However, alloying has a detrimental effect on thermal conductivity.

In addition to thermal and mechanical considerations, a material for a disc brake rotor must exhibit good wear resistance. In an unalloyed iron, wear resistance is primarily a function of the matrix structure and its hardness. Alloying the iron can create carbides so that wear resistance becomes more a function of the properties of the carbides. However, when vanadium, titanium and chromium are added to iron in excess quantities, a fall in the strength occurs arising from the formation of intergranular carbides in the matrix. Carbide stabilising elements such as chromium, molybdenum and vanadium also increase the tendency for the formation of free ferrite which is detrimental to the strength and tribological properties. For this reason, these elements are normally used at levels which are below those at which free carbides are formed so that the wear benefits of free carbides are not obtained. It is also considered that the use of high alloy structures containing free carbides would cause the formation of "hot spots" resulting in brake judder and heat cracking.

The present invention has the object of further increasing the thermal fatigue and wear resistance properties of a disc brake rotor.

The invention provides a disc brake rotor having a grey cast iron composition, characterised in that said composition comprises between 0.5 and 1.2% by weight of copper, and a plurality of hard carbide forming metals including both vanadium and titanium, the ratio between the weight of copper present and the total weight of said hard carbide forming metals being 1.8 to 3 units of copper to 1 unit of the one or more hard carbide forming metals.

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HKT
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CLAIMS

- 1 A disc brake rotor having a grey cast iron composition, characterised in that said composition comprises between 0.5 and 1.2% by weight of copper, and a plurality of hard carbide forming metals including both vanadium and titanium, the ratio between the weight of copper present and the total weight of said hard carbide forming metals being 1.8 to 3 units of copper to 1 unit of the one or more hard carbide forming metals.
- 2 A disc brake rotor according to claim 1, characterised in that the hard carbide forming metals also include one or more of tungsten, molybdenum, chromium, and niobium.
- 3 A disc brake rotor according to either one of claims 1 and 2, characterised in that the weight of vanadium present in the composition is less than or equal to one half of the weight of copper present added to 20 times the weight of titanium present.
- 4 A disc brake rotor according to any one of claims 1 to 3, characterised in that the carbon equivalent of the composition is between 4.2 and 4.55.
- 5 A disc brake rotor according to any one of claims 1 to 4, characterised in that the titanium content of the composition is between 0.025 and 0.035 wt%.
- 6 A disc brake rotor according to any one of claims 1 to 5, characterised in that the vanadium content of the composition is between 0.35 and 0.45 wt%.